In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
N_t=130
I_t=0
```

In [3]:
```
def red_wolf_population_df(N_0,I_0,time):
    df=pd.DataFrame({
        "Time (Years)":[0],
        "N_t":[N_0],
        "I_t":[I_0]})
    for i in np.arange(1,time+1):
        N_0=1.06*N_0+0.28*I_0
        I_0=10+0.57*I_0
        x={"Time (Years)":i,"N_t":N_0,"I_t":I_0}
        df=df.append(x,ignore_index=True)
    return df
```

In [4]:
```
df=red_wolf_population_df(130,0,5)
```

In [5]:
```
df
```

Out[5]:

	Time (Years)	N_t	I_t
0	0.0	130.000000	0.00000
1	1.0	137.800000	10.00000
2	2.0	148.868000	15.70000
3	3.0	162.196080	18.94900
4	4.0	177.233565	20.80093
5	5.0	193.691839	21.85653

In [6]:
```
def red_wolf_population_goal(N_0,I_0,goal_pop):
    t=0
    while N_0<goal_pop:
        N_0=1.06*N_0+0.28*I_0
        I_0=10+0.57*I_0
        t+=1
    return N_0,t
```

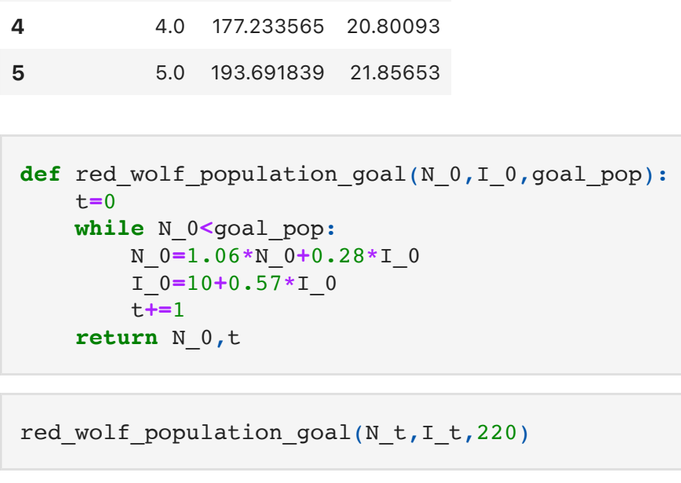
In [7]:
```
red_wolf_population_goal(N_t,I_t,220)
```

Out[7]:
```
(230.40747073691688, 7)
```

In [8]:
```
df_graph=red_wolf_population_df(130,0,200)
```

In [9]:
```
N_t_exp=np.exp(np.polyfit(x=df_graph["Time (Years)"][df_graph["I_t"]>22.255],y=np.log(df_graph["N_t"][df_graph["I_t"]>22.255]),deg=1))
```

In [10]:
```
sns.lineplot(data=df_graph,x="Time (Years)",y=N_t_exp[1]*np.power(N_t_exp[0],df_graph["Time (Years)"]),label="Regression Line N_t")
sns.scatterplot(data=df_graph,x="Time (Years)",y="N_t",label="N_t vs. Time")
sns.scatterplot(data=df_graph,x="Time (Years)",y="I_t", label="I_t vs. Time")
plt.ylabel("Population Count")
plt.savefig("Math_142_Homework_2_Q_1_a")
```



In [11]:
```
np.corrcoef(x=df_graph["Time (Years)"],y=np.log(df_graph["N_t"]))
```

Out[11]:
```
array([[1.       , 0.9996912],
       [0.9996912, 1.       ]])
```

In [12]:
```
L_c=np.array([[1,3/2],[2,1/2]])
```

In [13]:
```
N_c=np.array([[100],[200]])
```

In [14]:
```
np.matmul(L_c,N_c)
```

Out[14]:
```
array([[400.],
       [300.]])
```

In [15]:
```
def leslie_calc(L,N_0,time):
    df_L=pd.DataFrame({
    "time":[0],
    "N_0":[N_0[0][0]],
    "N_1":[N_0[1]][0]})
    for i in np.arange(1,time+1):
        N_0=np.matmul(L,N_0)
        x={"time":i,"N_0":N_0[0][0],"N_1":N_0[1][0]}
        df_L=df_L.append(x,ignore_index=True)
    return df_L
```

In [16]:
```
df_L_c=leslie_calc(L_c,N_c,3)
df_L_c
```

Out[16]:

	time	N_0	N_1
0	0.0	100.0	200.0
1	1.0	400.0	300.0
2	2.0	850.0	950.0
3	3.0	2275.0	2175.0

In [17]:
```
N_c_1=np.array([[1],[1]])
df_L_c_1=leslie_calc(L_c,N_c_1,6)
df_L_c_1
```

Out[17]:

	time	N_0	N_1
0	0.0	1.000000	1.000000
1	1.0	2.500000	2.500000
2	2.0	6.250000	6.250000
3	3.0	15.625000	15.625000
4	4.0	39.062500	39.062500
5	5.0	97.656250	97.656250
6	6.0	244.140625	244.140625

In [18]:
```
np.matmul(L_c,N_c_1)/2.5
```

Out[18]:
```
array([[1.],
       [1.]])
```

In [ ]:
```
```